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Making European-style community wind power development work in the US

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Abstract

Once primarily a European phenomenon, community wind power development—defined here as one or more locally owned, utility-scale wind turbines interconnected on either the customer or utility side of the meter—is gaining a foothold in an increasing number of states throughout the US. This article describes the various policies and incentives that Minnesota, Wisconsin, Iowa, and Massachusetts are using to support community wind power development, and how state and federal support influences the types of projects and ownership structures that are being developed. Experience in these states demonstrates that, with an array of incentives and creative financing schemes targeted at community-scale projects, there are opportunities to make community wind work in the US.

Keywords: Wind power; Community; Financing; Ownership; Economics; Policy

Contents

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1. Introduction

Traveling through the Danish countryside, one cannot help but notice the myriad large, utility-scale wind turbines that dot the landscape, either singly or in small clusters of several turbines. This is clearly wind power development on a different scale from what one typically encounters in the US, where a single wind farm might stretch on for miles and be sited far from load centers. In fact, it is an altogether different type of wind development and ownership model than typically found in the US: most of those Danish wind turbines are owned by one or more local residents, rather than by commercial investors, independent power producers, or utilities. And Denmark is not unique in this regard; 'community wind power' has also played a large role in Germany, Sweden, and, to a lesser extent, the Netherlands and the UK.

While US farmers interested in developing wind power on their land have for years looked with envy upon their northern European counterparts, local or 'community' wind ownership has nevertheless been slow to catch on in the US. This is in large part due to fundamental differences in the way that European and US governments have supported wind power at the national level [1]. For example, whereas the German government has created a 'user-friendly' guaranteed, stable, and profitable market for wind power through so-called 'feed-in' laws, the US government has supported wind power primarily through the tax code, via 5-year accelerated depreciation and the federal production tax credit (PTC). In order to benefit from these tax-based incentives, a wind project owner must have a significant tax liability, which simply is not the case with most farmers or other individuals who might otherwise be interested in owning a small commercial wind project. Hence, wind project ownership in the US has, for the last decade or more, been primarily limited to corporate owners with large 'appetites' for tax credits, who naturally prefer the economies of scale afforded by large wind projects.

Farmers, towns, schools, and local investors in the US are, however, beginning to invest in wind power projects. With the help of state policy support, new federal incentives, and creative local wind developers who have devised ownership structures that maximize the value of both state and federal support, community wind power is beginning to take a foothold in parts of the US, in particular the upper Midwest. The purpose of this article is to describe that foothold, as well as the state policy support that helped to create it.

But what exactly is 'community wind power'? Definitions vary widely, ranging from behind-the-meter installations to the Danish wind power 'cooperatives' to wind projects owned by municipal utilities. Possible defining criteria include: project size (small vs. large projects); purpose (to offset end-use power consumption vs. to sell power to the grid); ownership (single local vs. multiple local vs. municipal utility vs. commercial owners); and interconnection (behind the meter vs. to the distribution grid vs. to the transmission grid).

For the purposes of this article, 'community wind' is broadly defined as locally owned, utility-scale wind development that is interconnected to the grid on either the customer or utility side of the meter. In this case, 'locally owned' means that one or more members of the local community have a significant direct financial stake in the project, other than through land lease payments, tax revenue, or other payments in lieu of taxes. 'Utility-scale' refers to new projects consisting of one or more turbines of 600 kW or greater in nameplate capacity, or older projects in excess of 50 kW.[1]

Within the confines of this definition, this article first briefly summarizes Europe's experience with community wind, and the rather unique set of conditions that have historically favored community over commercial wind power development in several northern European countries. The article then turns to the US, where state-level policies in support of community wind power development are beginning to bear fruit, in spite of a challenging policy environment at the federal level.

2. Community wind in Europe

In early 2004, nearly three-quarters of the world's installed wind power capacity resided in Europe. One reason that wind power has flourished in Europe, particularly relative to other industrialized regions, is community participation in, and resulting acceptance of, wind power development. Table 1, adapted from Ref. [1], shows that at the end of the year 2000, roughly 80% of all wind power capacity in four northern European countries—Germany, Denmark, Sweden, and the UK—could be considered community-owned. Given that these four countries hosted roughly half of the world's installed wind power capacity at that time, community-owned projects accounted for roughly 40% of world wind power development at the end of 2000.

[1] 600 kW is currently the smallest turbine size offered by the major wind turbine manufacturers. Given, however, that some of the wind projects described in this article (and in particular in Iowa) are more than 5 years old, and that the nameplate capacity of utility-scale wind turbines has increased rapidly in recent years, older projects need not strictly adhere to the 600 kW threshold.

Table 1
Community wind power development in selected European countries (2000)

	Total wind capacity (MW)	Community-owned wind capacity (MW)	Percentage of community-owned (%)	Number of household investors
Germany	6161	~5400	88	~100,000
Denmark	2268	~1900	84	~175,000
Sweden	240	~30	13	~15,000
The UK	414	~3	1	~2000
Total	9083	7333	81	292,000

Community wind power ownership in Europe has been driven by a number of factors, as shown in Table 2, and described below.

Feed-in laws that require utilities to purchase wind power at premium prices have created accessible, stable, and profitable markets for community wind projects in Denmark and Sweden (historically), as well as Germany (to this day). Such laws provide long-term revenue certainty with relatively little associated transaction costs. The importance of feed-in laws to community wind can be seen in both Denmark and Sweden, where community wind development has in recent years effectively come to a halt as both countries transition away from feed-in tariffs towards more market-based (i.e. uncertain) support systems. Standardized interconnection rules and procedures in Denmark, Sweden, and Germany remove the uncertainty over who pays for interconnection and any necessary transmission upgrades. Furthermore, the presence of a relatively strong, three-phase electrical grid throughout much of Europe facilitates the interconnection of distributed, utility-scale wind projects by minimizing power quality impacts and the need for costly transmission upgrades [2].

Favorable tax treatment for wind power enhances its appeal as an investment. In Denmark and Sweden, for example, community wind investors are typically not taxed on income generated by wind projects, up to certain limits. Furthermore, several European countries tax energy consumption and CO_2 emissions, and in some cases these taxes flow through to wind project owners. Finally, up until recently German tax law allowed depreciation and other losses from investments in wind projects to offset taxes on ordinary (e.g. wage) income, thereby making community wind investments a popular tax shelter among wealthy Germans.

Table 2
Historical drivers of community wind power development

	Denmark	Sweden	Germany	UK	US
Feed-in laws	✓	✓	✓		
Standardized interconnection	✓	✓	✓		
Tax-free production income	✓	✓			
Energy/CO_2 tax refund	✓	✓		✓	
Flow-through depreciation			✓		
Wind turbine manufacturing industry	✓		✓		
Ownership restrictions	✓				
Permitting denials				✓	

The presence of a strong domestic wind turbine manufacturing industry has been an important driver in Denmark, where, in the early years of modern wind power development, turbine manufacturers often sent sales representatives out into the countryside to organize and facilitate community wind projects, with the ultimate objective of consummating turbine sales. Through this sales strategy, Danish wind turbine manufacturers co-evolved with the market for their product. In other words, by steadily filling orders for just a few turbines at a time, as opposed to hundreds or thousands of turbines destined for large California wind farms, Danish turbine manufacturers were able to test new products and discover and solve technical problems prior to mass production [3]. This is in contrast to the experience of Kenetech in the US, which became insolvent at least in part because of a premature push—stimulated by thousand-turbine orders—into mass production of largely un-tested wind turbine technology [4].

In Denmark, government-imposed ownership restrictions have historically *required* that wind projects be owned by members of the local community, based on the notion that those who benefit from feed-in laws should also bear the visual and aural burden of living near the wind turbine. Over the years, as the market for 'local' community wind projects has become increasingly saturated, Denmark has gradually relaxed its ownership restrictions, to the point where anyone in the European Union can now invest in a Danish wind project.

Finally, while the UK lacks most of the drivers present in Denmark, Sweden, and Germany, there has nevertheless been a concerted push towards community wind power development in the UK, in part as a result of the rash of permitting denials for larger commercial projects that swept the countryside a few years ago. Giving the local community a financial stake in the success of a project is seen as a way to bolster community support for that project.

3. Community wind in the US

The conditions that favor community wind power development in northern Europe are somewhat unique, and are not easily transplanted from country to country (even within Europe—e.g. witness the substantial difference between the UK and Denmark in Table 2). In fact, as shown in the final column of Table 2, the US has, at least historically, lacked virtually all of the drivers of community wind power development in Europe described above. Moreover, the primary forms of federal support for wind power in the US—namely the federal PTC and accelerated depreciation—are targeted at commercial, rather than community, investors. As a result, applying the European community wind model in the US is a challenge.

An increasing number of states, however, are actively taking on the community wind challenge, motivated by a number of factors that vary by state or region. In rural Midwestern states such as Minnesota, Wisconsin, and Iowa, community wind is seen as a way to help supplement and stabilize farmer income, and thereby contribute to the preservation of farming communities and the rural landscapes and values they sustain. Meanwhile, in the Northeast, densely populated states such as Massachusetts are recognizing that widespread large-scale commercial wind power development is perhaps unlikely within—and perhaps

even offshore from—their borders, and are turning to community-scale wind development to increase not only the amount of wind power on the grid, but also the public's knowledge, perception, and acceptance of wind power. The remainder of this article covers experience in these four states (more limited community wind activity in a few additional states is described in Ref. [5]).

3.1. Minnesota

A combination of favorable state policies specifically targeting 'small' (defined throughout this section as 2 MW or less) wind projects, a good wind resource, a largely rural agrarian population, motivated local wind developers, and active and well-organized advocacy groups have made Minnesota both the birthplace and current hotbed of community wind power in the US. More than 100 MW of community wind projects are currently selling power to the grid in Minnesota. This section begins by describing the most important drivers of community wind in Minnesota, including[2]:

- Xcel Energy's wind mandate,
- Minnesota's renewable energy objective,
- Xcel Energy's small wind tariff and standardized power purchase agreement,
- Minnesota's 10-year production incentive of 1.5 ¢/kW h,
- Xcel Energy's Renewable Development Fund (RDF),
- Minnesota Department of Commerce grants, and
- USDA Farm Bill grants.

This section concludes with a discussion of the current status of community wind in Minnesota, along with brief descriptions of some of the ownership models being employed.

3.1.1. Xcel Energy's wind mandate

A significant driver of community wind development in Minnesota has been a growing legislative mandate that the state's largest utility, Xcel Energy (formerly known as Northern States Power), support the development of a certain amount of wind capacity in exchange for the ability to store nuclear waste at its Prairie Island nuclear facility. While only recent portions of this mandate are specifically set aside for small wind development, Xcel has been applying small wind purchases towards its overall mandate for several years now, making this an important driver for community wind.

The original 1994 mandate required Xcel to own or acquire power from 425 MW of wind capacity by the end of 2002 (Xcel met this goal, with 480 MW under contract at the end of 2002), and an additional 400 MW at the discretion and timeline of the Minnesota

[2] Though not included among the major drivers of community wind in Minnesota, it is worth noting that wind turbines, as well as materials used to manufacture, construct, install, repair, or replace them, are exempt from Minnesota sales tax. Wind projects are also exempt from paying Minnesota property tax, though in 2002, a production tax was implemented in lieu of the property tax. For projects between 250 and 2 MW, the production tax is 0.012 ¢/kW h (amounting to US$ 630/year for a 2 MW project operating at a 30% capacity factor), but may be reduced or perhaps eliminated by local governments wishing to encourage wind development.

Public Utilities Commission (MPUC). In response to Xcel'S 1998 integrated resource plan, the MPUC directed the company to acquire this additional 400 MW of wind by the end of 2012.

It soon became clear, however, that with transmission capacity between load centers and the wind-rich Buffalo Ridge area in the southwestern corner of the state already strained, meeting the 2012 mandate would require significant transmission upgrades. As a result (and through a multi-stakeholder effort), Xcel applied for, and in early 2003 the MPUC granted, a Certificate of Need to construct four new high-voltage transmission lines to the Buffalo Ridge area. At the same time, in order to prevent these new lines—which Xcel expected to complete in 2006—from being underutilized until 2012, the MPUC moved the compliance date for the additional 400 MW of wind development forward by 6 years, to the end of 2006. More importantly for community wind, the MPUC also required that at least 60 of that 400 MW come from small, locally owned, aggregated wind generation projects.

Xcel's wind mandate was increased yet again in May 2003, with an additional 300 MW of wind capacity required by 2010, this time in exchange for extended nuclear waste storage rights. Of this 300 MW, 100 MW must come from small wind projects of 2 MW or less, (and that are *not* paid Minnesota's 1.5 ¢/kW h production incentive—more on this incentive below). With this latest addition, Xcel's aggregate wind mandate currently stands at 1125 MW: 425 MW by 2002 (met), an additional 400 MW by 2006 (60 MW of which must be from two or more aggregations of projects that are 2 MW or less),[3] and another 300 MW by 2010 (100 MW of which must be from projects of 2 MW or less).

3.1.2. Minnesota's renewable energy objective

In 2001, the Minnesota legislature enacted a 'renewable energy objective' for all utilities in the state. The objective, which utilities must make a *good-faith effort* to meet, starts at 1% of retail sales from eligible renewables in 2005, and increases by 1% per year until reaching 10% in 2015. Xcel's wind energy mandate, which at the time of enactment stood at 825 MW, may not be applied towards the objective.

In May 2003, the legislature amended the renewable energy objective to make it a *requirement* for Xcel Energy (while remaining an *objective* for all other utilities). Unlike its initial 825 MW wind mandate, however, the additional 300 MW of wind by 2010 that was added to Xcel's wind mandate in the same legislation (see Section 3.1.1) can be applied towards the objective. Although Xcel is technically the only utility *required* to meet the objective, other Minnesota utilities appear to be making good-faith efforts to comply.[4]

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[3] Due to extended regulatory proceedings over the new transmission lines and the 60 MW of small wind required, it is possible that the deadline for this portion of the mandate will be extended by a year to the end of 2007.

[4] For example, the renewable energy objective was reportedly the primary motivation behind Great River Energy's 2003 solicitation for 100 MW of renewable energy by 2005. Great River selected the community-based 100 MW Trimont wind farm as the successful bidder; contract negotiations are ongoing.

3.1.3. Xcel Energy's small wind tariff and PPA

To facilitate its mandated purchase of wind generation from small wind projects (and at the direction of the MPUC), Xcel offers a standard 'wind generation purchase agreement' as well as a 'small distributed wind generation purchase tariff'. The tariff is based on 'the lowest offered market price of wind projects valued' by Xcel, and currently stands at a fixed nominal price of 3.3 ¢/kW h for up to 20 years.

Standardized interconnection procedures and agreements are also being developed. These standardized purchase tariffs and agreements help to minimize transaction costs, which otherwise can be disproportionately damaging to small projects.

3.1.4. Minnesota's production incentive

A state cash production incentive of 1.5 ¢/kW h paid to small (2 MW or less) wind projects for the first 10 years of turbine operation has arguably been just as important as the combined impact of Xcel's wind mandate, small wind tariff, and standard purchase agreement in driving the development of community wind in Minnesota.[5] Enacted in 1997, this incentive was originally financed through statutory appropriations from the state's general fund, and was limited to the first 100 MW of small wind capacity to apply. In May 2003, however, the legislature expanded the incentive to cover an additional 100 MW of small wind capacity, to be financed with US$ 4.5 million per year from Xcel Energy's Renewable Development Fund (RDF) (more on this fund below).

In contrast to the initial 100 MW limit, which took more than 5 years to reach, the additional 100 MW was fully subscribed in *only 6 months*. Furthermore, as of late-January 2004, there were *more than 50 MW* of additional projects on a 'waiting list' established at the time the program became fully subscribed in November 2003.[6]

While some have opined that the recent surge in reservations is attributable to a 2003 change in the legislation that made municipal utilities and electric cooperatives eligible for the incentive, the numbers do not support such a contention: municipal utilities account for only 8.9 MW of the total 200 MW (no electric cooperatives have participated).[7]

Perhaps a more likely explanation for the quick pace of reservations is that local developers have, in the past year or two, developed and implemented viable ownership structures (more on these structures below) that allow these small projects to capture not

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[5] Because the energy must be sold in order to qualify for this incentive, grid-supply projects have dominated the program. Net-metered projects are eligible (there are currently around 40 net-metered installations totaling 1.55 MW that receive the incentive), but the incentive is only paid on any net excess generation that is 'sold' back to the utility, rendering it much less valuable than it is to grid-supply projects, whose entire output captures the incentive.

[6] At present the only hope for wait-listed projects is that an approved project will forfeit its right to the incentive (projects not completed within 18 months of reserving the incentive risk losing their place in the queue), or that the incentive will eventually be extended to cover additional capacity (an extension would require new legislation).

[7] In contrast to this recent broadening of eligibility to include municipal utilities and electric cooperatives, over the years eligibility rules have typically grown more restrictive. For example, for the first 2.5 years of the program, any wind project of 2 MW of less qualified for the incentive, regardless of who owned it. The rules were then amended to specify that only certain types of entities (e.g. farmers, nonprofits, agricultural landowners) were eligible for the incentive.

only the Minnesota production incentive, but also the federal PTC. With several highly publicized (and more importantly, replicable) examples of profitable ‘farmer-owned’ wind projects now up and running, these developers have captured the rural public’s attention and imagination, pushing community wind development past a ‘tipping point’ of sorts.[8]

3.1.5. Xcel Energy’s RDF

Also resulting from the 1994 Prairie Island legislation, Xcel’s RDF benefits community wind power in at least two ways. First, to date the fund has released two solicitations—one in 2001, and another in late 2003—seeking to fund innovative renewable energy projects. Among the winners of the first solicitation were a proposal involving three 1.8 MW wind projects with a community investment component, as well as a proposal for a 900 kW turbine to be sited behind the meter at the new Pipestone-Jasper school.[9] Proposals for the second solicitation were due on 16th March 2004. To qualify for this second round, wind projects must be 2 MW or less in size, should demonstrate some ‘novel concept, approach, setting, or application’, and cannot also receive Minnesota’s 10-year 1.5 ¢/kW h production incentive (which should not be an issue, unless the production incentive is extended). Moreover, wind projects funded through RDF solicitations may not be applied towards Xcel’s initial 825 MW wind mandate, but can be counted towards the most recent 300 MW addition to the mandate, as well as Minnesota’s renewable energy obligation.

Second, in May 2003 the legislature nearly doubled the amount of Xcel’s annual contribution to the RDF, and at the same time required that US$ 6 million/year (through 2017) of RDF funds be used for renewable energy production incentives, US$ 4.5 million of which would be dedicated to small wind. This funding enabled the previously mentioned 100 MW extension of the 1.5 ¢/kW h production incentive.

3.1.6. Minnesota department of commerce grants

In the fall of 2003, the Minnesota Department of Commerce State Energy Office made US$ 300,000 of oil overcharge funds available through a competitive solicitation to fund up to two community wind projects of at least 750 kW in size. The solicitation sought to geographically diversify wind development in the state by placing restrictions on where eligible projects could be sited. In early 2004, two projects were selected from a pool of eight applicants and awarded US$ 150,000 grants. The University of Minnesota, Morris West Central Research and Outreach Center plans to erect two

[8] Just as it did for larger projects, the scheduled expiration of the PTC at the end of 2003 no doubt also created some sense of urgency to complete any community wind projects that were in the development pipeline. Two-thirds of the projects that reserved Minnesota’s production incentives under the second 100 MW tranche, however, have not yet been built, and were likely too early in the development process to envision completion in 2003. Thus, the PTC’s expiration at the end of 2003 does not appear to have been the major cause of the rush to reserve production incentives.

[9] The three 1.8 MW projects will reportedly be interconnected to different distribution substations in Southwest Minnesota, and will incorporate a community investment component allowing local citizens to earn a return on the projects without having turbines sited on their land. These three projects have not yet been built, but have secured Minnesota’s 10-year production incentive of 1.5 ¢/kW h, in addition to the RDF grant of US$ 900,000. The Pipestone-Jasper school project, which received an RDF grant of US$ 752,835, was ultimately down-sized to a 750 kW turbine installed in 2003.

950 kW turbines, while a partnership between the Northfield school district and Carleton College will result in the installation of two contiguously sited, yet separately owned 1.65 MW turbines.[10]

3.1.7. USDA farm bill grants

In August 2003, the US Department of Agriculture (USDA) announced that it had awarded US$ 21.2 million in grants to 113 renewable energy and energy efficiency projects located in 24 states. The awards came from Section 9006 of the 2002 Farm Bill, the first farm bill ever to include an energy component.[11] Although these are federal—not state of Minnesota—grants, they are included here because Minnesota dominated the 'large' wind category, capturing 16 of the 25 grants, or US$ 3.9 of the US$ 7.2 million awarded to large wind projects.[12] At least 14 of these projects also successfully reserved Minnesota's 1.5 ¢/kW h 10-year production incentive before it was fully subscribed in November 2003.

3.1.8. Results

In combination, the many policies, programs, and incentives described above should eventually lead to *at least* 460 MW of 'community wind' in Minnesota[13]:

- 200 MW of small wind projects (i.e. projects that are, at least nominally, 2 MW or less in size[14]) that receive the 1.5 ¢/kW h production incentive;
- an additional 60 MW of aggregated small projects by 2006 (or more realistically, 2007) as part of Xcel's transmission upgrade;

[10] The partnership hopes to capitalize on the economies of scale from a shared site, yet each turbine will be separately owned and interconnected because the college and school district are two distinct entities (and so that each project might qualify for the state's 1.5 ¢/kW h production incentive for wind projects of 2 MW or less). Both projects plan to sell their output to Xcel under the small wind tariff.

[11] Due to time constraints, the fiscal year 2003 Farm Bill funding was made available through a onetime Notice of Funding Availability, which provided up to US$ 23 million in grants to enable agricultural producers or rural small businesses to purchase renewable energy systems or improve their energy efficiency. Grants were limited to 25% of eligible project costs (with a maximum grant of US$ 500,000), and the applicant was required to demonstrate financial need. Section 9006 has again been fully funded with US$ 23 million for fiscal year 2004, and the USDA is currently working to develop a proposed regulation that will outline how Section 9006 funding will be administered not only this year, but also in future years. Information on Section 9006 can be found at www.rurdev.usda.gov/rbs/farmbill/index.html, and Windustry also provides Farm Bill information at www.windustry.com/resources/farmbill.htm.

[12] Few of these projects are truly 'large' by today's standards; most involve only one or two turbines. The label large is simply intended to differentiate these utility-scale projects from much smaller (e.g. 10 kW) wind projects that were also funded under Section 9006. The remaining nine large wind grants were distributed among seven states, including Iowa (2 grants), Idaho (1), Illinois (2), Massachusetts (1), New York (1), Texas (1), and Virginia (1). A few of these other grants are mentioned later.

[13] Not all of this capacity strictly meets our definition of community wind (e.g. see footnotes 15 and 17).

[14] In some instances, what would otherwise be considered a much larger project (based on contiguous turbine siting, and/or related ownership) has been legally sub-divided into a number of smaller projects of 2 MW less in order to capture the Minnesota's production incentive. While the incentive legislation contains provisions to guard against this sort of gaming, developers and project owners have devised a number of creative ways to effectively bypass such provisions while remaining within the letter of the law.

- another 100 MW of small projects by 2010 as part of Xcel's wind mandate; and
- the 100 MW Trimont project, which Great River Energy plans to apply towards Minnesota's renewable energy objective.

As of late January 2004, roughly 132 MW of this 460 MW had been built, and at least another 68 MW was likely (presuming imminent extension of the federal PTC) to come online before mid-2005 under Minnesota's production incentive (which requires that projects be built within 18 months after reserving the incentive).

While many, but not all, of the projects that have been built are locally owned (and therefore fit within our definition of 'community wind'), only a few of them are owned by multiple local investors who each purchase one or more shares in the project (i.e. the 'multiple local owner' or 'European' model). The majority of the rest of the projects are financed either through traditional commercial avenues,[15] individual personal wealth,[16] or what is known as a 'flip' structure, whereby a tax-motivated corporate investor passively owns most or all of the project for the first 10 years, and then flips the ownership of the project to the local investor(s) thereafter.[17]

Of these various ownership structures, commercially financed projects do not conform to our definition of community wind, while projects financed through individual personal wealth (which *do* qualify as community wind under our definition) represent a model that is most likely not widely replicable. That leaves the 'multiple local owner' and flip structures, which are the most interesting from a community wind perspective, since they enable local individuals to participate in the ownership of a commercial wind project without undue capital outlay. Both of these structures will be briefly discussed below.

But first, any discussion of community wind ownership structures needs to be placed in the context of federal support for wind power, which, as mentioned in Section 1 to this article, has come primarily from the PTC, as well as 5-year accelerated depreciation. Obviously, these tax-based incentives are only available to project owners with tax liability, a fact that handicaps ownership structures involving non-taxable entities such as cooperatives or non-profits. While there is another federal incentive—the Renewable Energy Production Incentive or REPI—intended to provide a similar amount of value as the PTC to non-taxable entities, funding for the REPI is limited and subject to annual

[15] For example, Northern Alternative Energy packaged together and financed approximately 30 MW of small wind projects in Minnesota with US$ 25 million in debt from the now-defunct ABB Energy Capital. ENEL North America, a subsidiary of the large Italian utility, owns a majority stake in the projects.

[16] For example, Garwin McNeilus is a wealthy Minnesotan who has reportedly used his savings to develop and own at least 19 wind projects (totaling 34.5 MW) that have been funded by the Minnesota's production incentive to date. McNeilus donates a portion of the proceeds from at least six of these projects to organizations that provide support for underprivileged children in developing countries around the world.

[17] The relative proportions of the various financing/ownership structures employed among the 132 MW of projects that have been built under Minnesota's production incentive to date are roughly as follows: commercial (40%), individual personal wealth (26%), flip (22%), municipal utilities (7%), multiple local owners (3%), and school projects ($<1\%$). Including the additional 68 MW of projects in the queue (i.e. to get to the 200 MW total), the relative proportions shift to roughly 29, 17, 39, 4, 8, and 2%, respectively, reflecting a likely increase in flips and projects financed by multiple local owners. Note that only those projects financed through individual personal wealth, flips, multiple local owners, and schools fit within our definition of community wind; such projects total roughly 52% of the 132 MW of built capacity, and roughly 65% of the total 200 MW.

congressional appropriations (as opposed to the PTC, which requires no cash outlay and is guaranteed for 10 years), rendering it of significantly less worth than the PTC.[18] Furthermore, even if non-taxable entities are able to capture the REPI, they still cannot benefit from accelerated depreciation.

In part as a result of these federal incentives, the 'wind cooperatives' that one typically associates with northern Europe are not a financially attractive model in the US.[19] A more promising vehicle appears to be a limited liability corporation (LLC), which combines the single taxation of a partnership (i.e. income from the LLC is reported solely on the individual investors' tax returns) with the limited liability of a corporation, and is also sufficiently flexible to serve as an investment vehicle organized according to cooperative principles. In this way, an LLC can offer many of the benefits of a cooperative, without the associated restrictions.

While the LLC vehicle is readily available, the investors that form the LLC must still have tax appetite in order to benefit from the PTC and accelerated depreciation. In fact, if investment in a community wind LLC is considered a *passive* investment (as it presumably would be for most investors not involved in the day-to-day management of the project), then the investor must have other *passive* forms of income (e.g. rental income, but *not* interest and dividend income) against which to claim the PTC. This passive/active distinction further limits the universe of potential community wind investors, and has given rise to at least two innovative community wind ownership structures in Minnesota: (1) an LLC comprised of multiple local investors, each with sufficient passive tax credit appetite (i.e. the 'multiple local owner' model mentioned above), and (2) an LLC comprised of a single local investor (e.g. a farmer) with insufficient tax credit appetite, and a tax-motivated corporate investor who effectively owns the project (at least financially) during the period of tax benefits (i.e. the first 10 years), and then surrenders financial control to the local investor thereafter (i.e. the flip structure mentioned above).

At present, the only working examples of the first model—an LLC comprised of multiple local investors with sufficient passive tax credit appetite—are the Minwind I and II projects [6]. Each project consists of two turbines totaling 1.9 MW, so as to qualify for Minnesota's 1.5 ¢/kW h production incentive. The two projects reportedly cost a total of US$ 3.6 million, 70% of which was financed through loans from a local bank, while the remaining 30% was raised through the sale of project shares (at US$ 5000/share). The LLC agreement specifies that 85% of each project's shares must be farmer-owned, and no single person can own more than 15% of a project's shares. The equity required to finance both projects (i.e., ∼US$ 1.1 million) was reportedly raised from among 66 investors in just 12 days, with each investor cognizant of the passive income limitations on the PTC

[18] It should be noted that the REPI expired (for new projects) in late 2003 and has not been re-authorized. The wind industry, however, expects that both incentives will be re-authorized in the near future.

[19] In fact, despite their reputation as such, very few European community wind projects are legally organized as cooperatives. Most Danish community wind projects, for example, are structured as partnerships [1]. Besides the tax issue, another hurdle relating to cooperatives involves the concept of 'patronage'—i.e. cooperative members benefit based on how much they *use* the cooperative, rather than how much they have *invested* in it. Unless investment in a community wind project can somehow be tied to use of the wind power—which is challenging given the nature of electricity and how it is delivered over the grid—it is difficult to document patronage.

and investing accordingly. With the federal PTC, Minnesota's production incentive, and a 15-year power purchase agreement with Alliant Energy, Minwind investors can reportedly expect to earn an average annual return of 17% over the project's life. Interest in the first two Minwind projects was so strong that there are currently seven additional 1.65 MW projects—Minwind III–IX—in development. Each of these seven projects will receive the Minnesota's production incentive, as well as a USDA grant of US$ 178,201.

In part because they require far less coordination than the Minwind model,[20] flip structures are relatively more common in Minnesota. Pioneered by local developer Dan Juhl, the flip structure is, in some ways, tailor-made to fit within the legal requirements of the state's 1.5 ¢/kW h production incentive. For example, during the first 10 years of the project, the farmer owns (at least in a financial sense) as little as 1% of the project, yet retains 51% voting rights in order to comply with a legislative requirement that the project be at least 51% owned by certain entities (tax-motivated corporate equity investors not necessarily among them) in order to qualify for the incentive. During this initial 10-year period, the only income the farmer earns from the project is a small 'management fee', calculated as some percentage of the project's gross revenue. The tax-motivated corporate equity investor, meanwhile, benefits from the PTC, accelerated depreciation, power sales revenue, and Minnesota's production incentive (less O & M expense and debt service). Once the equity investor has met its return hurdle—typically at the end of year 10, when the PTC ends—ownership in the project flips and the equity investor essentially drops out of the project, leaving the local farmer with a debt-free wind project. Roughly 30 MW of small wind projects in Minnesota have been financed in this manner to date, with many more such projects in development.

In addition to the Minwind and flip models, there are two other 'ownership' structures evolving in Minnesota that deserve mention. The first involves ownership by a school district, where the project is financed through either a loan or a municipal bond issuance, and sells power to Xcel under the small wind tariff. The Northfield school district is currently pursuing this model.[21]

The second relates to the proposed 100 MW Trimont wind project, which was conceived by an LLC consisting of 45 local landowners and investors who undertook most of the pre-development. Recently, the local LLC has brought in a subsidiary of PPM Energy to develop, construct, own, and operate the project for the duration of its lifetime. This transfer of control did not occur through a sale, however. Instead, the local investors have effectively granted the project to PPM in exchange for a secured interest in the project's success (i.e. a percentage of gross revenue). If all goes well, this arrangement will

[20] While flips have typically involved a single farmers or farm family, a number of unrelated farmer could conceivably form an LLC and bring in a tax-motivated investor to flip the project to them. There are two possible reasons for going this route. First, spreading out the local investment in this manner would reduce each farmer's capital contribution (and risk). Second, it could be that a group of farmers may collectively have some passive income, but not enough to fully utilize the tax benefits of the project, in which case the tax-motivated investor would make up the difference (i.e. a hybrid between a Minwind-style LLC and a flip structure).

[21] While Carleton College plans to install a 1.65 MW wind turbine at the same site as Northfield's proposed installation, Carleton will pay cash for its turbine (out of its endowment), which may not be widely replicable model. As mentioned earlier, the Pipestone-Jasper school district also has a wind turbine, though nearly all of that project was financed through a grant from Xcel's RDF.

prove to be more lucrative to the local investors than an outright sale would have been. This emerging model, which combines the economies of scale from a large project, the credibility and expertise of a large wind developer, and community 'owners' who can deliver community acceptance of the project (along with associated transmission development), is reportedly garnering much attention in the Midwest.

3.2. Wisconsin

Community wind is just beginning to take root in Wisconsin, which lacks not only the superior wind resource of its neighbor to the west, but also the broad range of policies and incentives supporting smaller wind projects in Minnesota.

In 2003, *Wisconsin Focus on Energy* (the state's clean energy fund, financed by a small surcharge on electricity bills) funded Cooperative Development Services of Madison to develop, with assistance from a group of stakeholders, a generic and replicable business plan for community wind projects in Wisconsin [7]. The resulting 'Wisconsin Community Based Windpower Project Business Plan' is a thoroughly researched and detailed reference document describing a variation of the flip structures employed in Minnesota.

In the proposed structure, a group of local investors with limited or no tax appetite pool enough capital (through sales of US$ 5000 shares) into an LLC to cover 20% of the total costs of a 3 MW wind project. The LLC 'loans' this amount to a tax-motivated corporate investor, who in turn contributes another 30% of total project costs in the form of equity, and borrows the remaining 50% from a commercial lender, resulting in a debt/equity ratio of 70/30% for the project as a whole. The corporate investor owns the project for the first 10 years and benefits from the federal PTC and accelerated depreciation, as well as revenue from the sale of power and tradable renewable certificates (TRCs) (assumed to provide 3.5 and 1.0 ¢/kW h, respectively). At the same time, it services the project's debt, repaying the entire 10-year commercial loan, as well as interest—but not principal—on the loan from the local LLC.[22] At the end of the 10th year, with its minimum return hurdle met, the corporate investor simply drops out of the project, retaining the LLC's loan principal as payment for the turbine. At this point, the local LLC assumes ownership of the project, which is now free of debt, and therefore quite profitable.

This structure differs from the flip structures most commonly employed in Minnesota in two ways. First, the local LLC is comprised of a group of local investors, rather than a single farmer. Second, the local LLC's capital contribution is structured as a loan, and the income it receives over the first 10 years therefore comes in the form of interest rather than a project management fee.

Accompanying financial analysis (as amended by the author) of the Wisconsin model reveals that, even with no state incentives and reasonable cost and revenue assumptions, the corporation's after-tax internal rate of return (IRR) is roughly 14%, while the LLC investor can expect around 8% (pre-tax). Such returns may be sufficient to attract both types of investors. With the business plan recently completed, the stakeholder group

[22] These limited, though steady, interest payments provide the sole source of income to the local LLC over the initial 10-year period of corporate ownership.

continues to meet and is now focusing its efforts on marketing and outreach activities, in the hopes of identifying a local champion to put the plan into action.

3.3. Iowa

Community wind projects in Iowa have been dominated by utility-scale behind the-meter installations, primarily at public schools. Currently, eight schools host 10 wind turbines ranging in size from 50 up to 750 kW, with a combined capacity of 3.6 MW. In addition to Iowa's strong wind resource, two main factors have historically converged to create a favorable environment for this particular model.[23]

First, Iowa's 1993 statewide net metering (called 'net billing' in Iowa) law is unusual in that it does not specify a limit on the size of eligible generators. While legal challenges from the state's investor-owned utilities have resulted in recent changes to net billing practices (more on this below), at least historically, the lack of a size limit has enabled the use of utility-scale wind turbines in net-metered applications. Excess generation (i.e. generation that exceeds current load) has historically been 'banked' with the utility, and if not used by the end of the month, sold to the utility at its avoided cost. In conjunction with single-part tariffs (i.e. just an energy charge, with no separate demand or standby charges) for many non-residential customers,[24] net billing has historically enabled schools and other medium to large end-users to essentially eliminate their monthly electricity bills, resulting in savings of roughly 8 ¢/kW h (the retail rate) for all generation up to total consumption, and revenue of 2 ¢/kW h (the utility's avoided cost) for any net excess generation. In addition, net excess generation at schools has historically earned the federal REPI, which stood at 1.8 ¢/kW h before expiring in late 2003.

Second, in many cases turbine owners need not produce any up-front cash, making wind projects a budget-neutral (or even budget-positive) investment. Iowa's Alternate Energy Revolving Loan Program (AERLP) enables customers served by investor-owned utilities to borrow *the full cost* of a wind turbine project at attractive interest rates. The AERLP, which was created in 1996 and funded with a total of US$ 5.9 million through a 3-year surcharge on the in-state electricity sales Iowa's investor-owned utilities, will provide half of the required loan (up to US$ 250,000) *at 0% interest* for terms not exceeding 20 years.

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[23] It should be noted that the environment is favorable not only to wind at schools, but also to wind at private commercial facilities. There are, however, only a few utility-scale wind turbines sited at commercial facilities in Iowa: Schafer Systems, Inc. installed a 225 kW wind turbine behind the meter in 1995, while the Story Country Hospital installed a 250 kW turbine in 1993 (in addition, a radio station and a truckstop each host 65 kW wind turbines).

[24] A two-part tariff that includes a demand (i.e. per maximum kW) charge as well as an energy (i.e. per kW h) charge would reduce the attractiveness of a behind-the-meter wind project, unless the diurnal and seasonal wind production profile closely matched the customer's load profile (i.e. unless the wind power consistently reduced not only the customer's energy consumption, but also maximum demand). While such a tight match between production and load is unlikely to occur in most cases, even if it did exist, standby charges (i.e. charges based on any shortfall of actual demand below contractual demand) might then apply. For these reasons, an intermittent generator such as a wind turbine will fare best in a behind-the-meter application under a single-part tariff based solely on energy consumption (and not demand). It is not uncommon for commercial and industrial customers in Iowa to have the choice of either a single- or two-part tariff.

The AERLP requires that the remainder of the loan (i.e. half or more of total financing) come from a private lending institution of the applicant's choice, thereby ensuring that the project passes not only technical due diligence (performed by the AERLP), but also financial due diligence (performed by the private lending institution). If the applicant is a public or non-profit entity, it can satisfy the AERLP's private lending requirement by working with the Iowa Energy Bank, which operates under the Department of Natural Resources to help qualifying energy projects negotiate low interest loans through private lenders.

The end result is that Iowa schools have been able to borrow up to US$ 800,000 to completely finance the installation of a utility-scale (e.g. 750 kW) wind turbine at blended interest rates of just 3–4%. In combination with net billing, this low rate of interest has in some cases created immediate positive cash flow, allowing loans to be repaid in just 4–6 years [8–10]. Five of the eight school districts with wind turbines have financed their projects in this manner.[25]

While attractive loan programs and net billing policies have made Iowa fertile ground for school-based wind development in the past, the outlook for this type of development going forward is less rosy. In late 2001, MidAmerican—the state's largest utility—reached a settlement with stakeholders over its multi-year legal challenge to Iowa's net billing law. The settlement included limiting the capacity from net-metered generators to 500 kW,[26] and rolling any net excess generation (from the 500 kW net metered portion of a project) forward indefinitely from month to month, with no obligation to ever pay for it. In early 2002, the Iowa Utilities Board granted MidAmerican a waiver implementing these changes. The state's other major utility—Interstate Power and Light Company — received a similar waiver in January 2004.

With the 500 kW net billing size limit now in place, making the economies of a school-based wind turbine work is likely to become more of a challenge. Presuming that the utility will not be willing to pay much for power in excess of 500 kW, it will most likely be in a school's best interest to install a turbine sized under this threshold. There are, however, very few utility-scale turbines being built in this size range (100–500 kW) today. Moreover, smaller turbines typically cost more per kW (and per kW h) than larger turbines, and are therefore less economical. On the positive side, less capital is required to finance a smaller turbine, meaning that a larger proportion of the total loan can be financed at 0% interest through the AERLP.

3.4. Massachusetts

In September 2003, the Massachusetts Technology Collaborative (MTC), which administers the state's Renewable Energy Trust Fund, launched a US$ 4 million

[25] Two of the remaining three school districts installed their turbines prior to the inception of the AERLP, while the third district received its two wind turbines from a local benefactor.

[26] Importantly, the 500 kW limit specifies the maximum amount of *capacity* that will be net metered at any one location, and does not limit the maximum size of the *generator* to be net metered. In other words, a customer that installs a 750 kW wind turbine can still be on a net metering tariff, but only the first 500 kW of power from the turbine will be net metered (any excess power will be sold to Mid-American through standard or PURPA contracts).

'Community Wind Collaborative' ('the collaborative'). The collaborative was conceived out of the sharp contrast between the highly publicized debate over the proposed 420 MW offshore. Cape Wind project, and the tremendous community support for Hull Municipal Light's single 660 kW turbine on the rim of Boston Harbor. Notwithstanding the potential merits of the Cape Wind project, in a state (and region) that has to date experienced very little wind power development, projects of the scale seen at Hull arguably provide a less divisive introduction to modern utility-scale wind power. Yet such small projects are often not sufficiently lucrative to attract the interest of a typical commercial wind project developer. Seeking to fill this gap, MTC launched the community wind collaborative to provide pre-development and development services for such projects, with the goal of not only increasing the capacity of wind power in the state, but at the same time nurturing a positive perception of wind power throughout local communities statewide.

Any city or town in Massachusetts with a sufficient wind resource is eligible to participate in the collaborative.[27] MTC has developed (through TrueWind Solutions) detailed wind resource maps for each of the state's 351 cities and towns, upon which it has overlaid other maps showing all municipal- and state-owned property. Those cities or towns that have class 4 or higher wind resources on publicly owned land—i.e. 119 of the state's 351 municipalities—are considered prime candidates for participation in the collaborative.[28]

MTC has identified seven phases of development that it will support through the collaborative [11]

1. Project conceptualization and site identification,
2. Wind measurement and monitoring,
3. Feasibility analysis (both technical and economic),
4. Public outreach and feedback,
5. Project financing,
6. Project construction, and
7. Project operation and maintenance.

At present, MTC will provide—at no cost to the local community—technical expertise and resources to help eligible cities and towns proceed through the first four phases. To that end, in late December 2003 MTC released a 'Request for Proposals from Technical Consultants' to establish a pool of qualified consultants able to assist MTC and communities in carrying out the pre-development and development activities embedded in phases 1–4 [12]. Responses to the RFP were due in late February 2004.

If, after completing phase 4, a wind project proves to be feasible and the community is interested in proceeding, MTC will support development phases 5–7 primarily through its

[27] MTC may also work with municipal light plants (i.e. municipal utilities) such as Hull, though likely at a lower level of engagement and support, since municipal utilities do not pay into the Renewable Energy Trust Fund.

[28] Communities with class 3 wind resources will also be considered, though MTC notes that estimated economics of class 3 projects border on being prohibitive. MTC hopes that communities with insufficient wind resources to develop their own local projects will consider partnering with other communities that do develop projects, either as partial investors (e.g. through an LLC arrangement) or as long-term buyers of power and/or TRCs.

Preferred Partner Program, which will offer communities access to bundled equipment, construction, and extended O and M packages at favorable prices (and low transaction costs). A solicitation for preferred partners is forthcoming in the near future.[29]

While participation in the collaborative is limited to municipalities, MTC does not rule out the possibility that a municipality may bring in a private entity to develop and own the project. For example, rather than finance and own the project itself, a municipality could decide to proceed through phases 5–7 by: (1) allowing a limited liability company (LLC) to finance the project through the sale of shares to the local community (e.g. the Minwind model, described under Minnesota); or perhaps even (2) allowing a private wind developer/owner to construct and own the project. Hence, while the focus on phases 1–4 is on municipalities and publicly owned land, it is not a foregone conclusion that projects developed through the collaborative will be municipal-owned.

MTC envisions that the collaborative will result in projects that sell power to the grid, as well as those sited behind the meter.[30] Both types of projects present their own economic challenges. If the past is any indication of future trends, grid supply projects may have difficulty in finding creditworthy long-term purchasers of power and TRCs, and may have to instead rely on shorter term contracts or other forms of long-term price support such as MTC's Green Power Partnership Program.[31] Behind-the-meter installations, meanwhile, will likely not receive the benefits of net metering (which is limited to 60 kW in Massachusetts), and may even face standby charges. Furthermore, because suitable project sites are likely to be relatively scarce in Massachusetts, MTC hopes that behind-the-meter projects will utilize as large of a turbine as is technically feasible, even if it means that a substantial fraction of total generation is fed back into the grid at spot market prices. Because it is not driven by economic considerations, this 'over-build' strategy will likely hurt the economics of a behind-the-meter installation.

Although the collaborative has only been operative for a few months, it has made good progress to date. Forty communities have expressed interest in the collaborative and are at various stages of project development. Wind monitoring (i.e. phase 2 of the seven-phase development process), conducted by the University of Massachusetts' Renewable Energy Resource Laboratory, is already underway in six communities, and an additional four meteorological towers will be installed by June 2004. A pool of technical consultants should be on retainer by the end of March to begin feasibility analyses and outreach (phases 3 and 4), and MTC anticipates that three feasibility studies will be underway by July 2004. Finally, the preferred partnership solicitation (applicable to phases 5–7) will be issued shortly.

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[29] As currently planned, this solicitation will not offer financial incentives to entice preferred partner participation. Instead, preferred partners are expected to benefit from having access to a captive market. For example, for wind turbines in excess of 500 kW, MTC envisions contracting with a single preferred partner that will then have the market more or less all to itself.

[30] For example, a number of communities are specifically looking to co-site wind projects with municipal waste water treatment facilities or water pumping and treatment projects.

[31] For more information on this program, which provides price risk insurance to project developers, see Ref. [13].

4. Conclusions

Though historically confined to Europe, ‘community wind’ projects are a topic of increasing interest in the US, not just among farmers and other potential local investors, but also among state policymakers interested in renewable energy. Several states are currently supporting community wind in a variety of ways, leading to the development of different types of projects (e.g. grid supply projects in Minnesota, net-metered projects in Iowa, and, perhaps in the near future, municipal-owned projects in Massachusetts). Experience in these states demonstrates that, with an array of incentives and creative financing schemas targeted at community-scale projects, there are opportunities to make community wind work in the US.

Where individual local investors are involved, the potential availability of federal tax-based incentives has motivated the use of innovative ownership structures to maximize both state *and* federal incentives. One such structure seeks to distribute ownership across enough local investors such that they can collectively utilize the full value of federal tax credits. Another brings in a tax-motivated equity partner to utilize the federal credits in the project’s early years, and then flip project ownership to local investors thereafter. With a number of these replicable ownership models now being successfully demonstrated and documented, and with the policy support of an increasing number of states, community wind in the US may very well be approaching a ‘tipping point’.

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